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INFORMATICS AND EDUCATION IN BRAZIL

by

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FOREWORD

This text presents a survey on how computers in Brazil have been used in education. It has been a challenging process, that can be better understood if one can see it as one of the consequences of a broader movement (which began in the fifties) of the brazilian society to appropriate the computer technology. As much for that, an overview on the informatics sector in the country - historical background, governmental policy, national investments on research - was included in the text.

The motivation to prepare this report is twofold. Firstly, due to my background in computer science and, secondly, due to my concern for educational problems, I became naturally interested in the problem of how computers could be used in benefit of education. Last July/1987, I began to make contact with people in Brazil who had the same interests and had greater experience in the field.

The first contact I made was with Dr. J.Barreto, member of the Institut d'Informatique, Facultés Universitaires Notre Dame de La Paix (FUNDP), who was in Brazil for presenting a conference on the subject, in the XXXIX Annual Meeting of Brazilian Society for the Progress of Science. He gave me the necessary motivation to go further, meet people, visit institutions, know about the work that has been done in Brazil, and to deepen my knowledge on the subject through reading.

After my arrival in Belgium, the conversations I had with other members of the Institute and the seminar "Informatique et Développement" that took place there during the "Journées Universitaires de la Paix" (29/fév-04/mar,1988) gave me the idea that it would be interesting to present a survey of the historical developments of the field of informatics in Brazil and their applications to the learning process. Besides, most of the material published in Europe ([DELTA,86], [Vasques,87]) about the experience each country in the world had in the field shows a lack of information when the one involved is Brazil. I hope this text can help fulfilling it.

INTRODUCTION

This work is divided into four chapters. Chapter I retraces the main points of the informatics sector in Brazil, that followed a different path from other Latin American countries. In Chapter II we attempted to highlight some of the social aspects of the introduction of computers in education, specially in precollege education. Chapter III presents the lines of work that has been developed in the country, describing the main initiatives of the government in this area as well as some of the initiatives of the private sector. Finally, Chapter IV deals with the trends for future work.

We want to acknowledge Mr. Jorge Barreto, Mr. Guy Thiry, Mr. Mete Celiktin and Mrs.Claire Lobet-Maris for their interest in our work as well as for their useful comments on earlier versions of this text. We thank Prof. Claude Cherton, Director of the Language and Programming Department, who welcomed us at the "Institut d'Informatique", FUNDP, for the resources made available to our work. We also thank the National Council of Scientific and Technological Development (CNPq) for the material support given to develop this work (scholarship n° 201139/87).

CHAPTER I

INFORMATICS IN BRAZIL : AN OVERVIEW

The history of computation in Brazil had many stages. After World War II the brazilian government sent many people abroad to make their graduate studies. When they came back to the country, they showed the need for a new working environment in the brazilian universities, an environment that would incorporate the computer technology. They began to organize themselves and make efforts to fulfil their expectations, so that, at the decade of the sixties, computer use in the scientific field began to appear, initiating a stage where the universities had an important role.

The process of introducing informatics in the scientific activities began with the acquisition of well-known computers commercialized in the international market. The first one that entered the country was a Burroughs Datatron B205 computer, bought by a consortium composed of the Pontifical Catholic University of Rio de Janeiro (where the machine was installed), the National Council of Scientific and Technological Development (CNPq) and the government, in 1960, to scientific purposes [Von Staa,83]. This computer, as most of the computers of that time, had limited computational power and extremely high cost. Just to give an idea, it performed an addition operation in 0.1 milliseconds, it had 20 K bytes of memory and no software support was available (no operating system, no compiler, etc). Programming was done in absolute machine language. Nowadays, a microcomputer offers a much greater computational power and a much lesser cost (5000 times!)

Three years later, the Brazilian Institute of Geography and Statistics bought a UNIVAC computer which was also used by the Federal University of Rio de Janeiro in the academic and scientific activities. The acquisition of this computer was followed by a series of others. The Technological Institute of Aeronautic (São José dos Campos, São Paulo), for example, had an IBM 1620 computer installed. During this decade, not only the number of high performance machines installed in the country increased, but also significant investments were made on research and on qualification of human resources in the country. Among other computers, an IBM 1130 model was

installed at the Federal University of Minas Gerais (1965), at the Pontifical Catholic University of Rio de Janeiro (1966), and at the Federal University of Rio de Janeiro (1967).

At the same time that the acquisition process of high technology machines was going on, an effort was being made in the country to develop the know-how for these machines. The first successful effort was an experimental computer, developed and built in the Military Institute of Engineering, Rio de Janeiro, in 1960, and whose project was oriented by Prof. Rudolf Theodore Schreier, a pioneer in the computer field [Randell,75]. In [Barreto,60] and [Ditz,60] we have a partial description of the subject. This project was not alone. Other national computer projects were developed as the one done in the Electronic Laboratory of the Technological Institute of Aeronautic.

By the end of the sixties, the idea of studying computation as a science was growing up. The biggest universities in Brazil began to offer graduate studies on the subject, which were often part of their programs of electrical engineering. Shortly after, undergraduate studies were available. All this activity in the university led to the definition of research lines on computer science. A great effort was done, at first, toward the development of software, stimulating local projects. By the middle of the seventies, hardware development began to deserve greater attention, for Brazil should search a more complete control of computer technology in order to avoid the consequences of technological dependence. So much for that, by the end of the decade, we could talk about a brazilian industry of data processing equipments.

The work taken up in the research centers of the country improved the national computer industry, opening new perspectives in other areas. However, in parallel to this research work, a political work was also needed. All the people that returned to the country, after having studied and worked abroad in the informatics area, and were by now benefiting their country with their experience, aimed and worked for a policy for the sector to protect their creativity. It should also be pointed out that government rules and qualified human resources would not have been enough if they did not receive support of managers that accepted the challenge.

The main feature of the brazilian policy of informatics was the emphasis in the need for achieving a local technological capability. Another feature is the idea that this capability can only be achieved by genuinely national enterprises. Shortly speaking, a "national enterprise" is the one that:

- is constituted under the brazilian laws;
- has its headquarters and administration in the country;
- has its capital controlled by natural person resident in the country or by entities of internal public power.

An enterprise with those characteristics is believed to have autonomy to decide on the process of selection and development of technology, therefore achieving the technological capability desired. In 1977, it was implemented the policy of the reserve of market for national enterprises in the most dynamic sectors of industry (small computers and peripherals) which were not yet occupied by foreigner manufacturers. In 1979, the Special Informatics Secretariat (SEI) was created, whose function was to supervise the application of the policy of reserve of market. This policy, by then, was extended to the microelectronic and superminicomputers sectors. A more detailed analysis of the policy for the sector can be found in [Adler,84], [Ramamurti,85], [Frishchtak,85], [Graham,85].

The so-called Law of Informatics was approved by the Brazilian National Congress in 1984. This law reassured the basic principles of technological capability and of reserve of market, and created the National Council of Informatics and Automation. The council is constituted by representatives of the public and private sector, and has the function of discussing and deciding on the national policy for the sector. By the end of 1985, the National Congress approved the National Plan of Informatics and Automation whose objectives included those previously stated, and also decided on the means to achieve them: fiscal inducements besides the reserve of market. A description of the Law of Informatics - its philosophy - can be found in [Ditz,86], where the text of each article and paragraph is followed by an explanation of the legislator's intention.

Since the late seventies the brazilian industry of data processing equipments has been experiencing a significant growth. We should say the informatics sector was not much affected by the brazilian economical crises of the eighties. From 1980 to 1983, the rough national product decreased of 4% and, in the same period, the billing of the national industry of data processing equipments increased of 73%. In addition, the brazilian enterprises had 23 % of the industry billing in 1979, and this rate went up to 50 % in 1985. Table I [Tigre,87] shows the evolution of the brazilian industry of data processing equipments in the period - its billing was multiplied by a factor of ten in six years.

TABLE-I

BILLING OF BRAZILIAN INDUSTRY OF INFORMATICS (1979-85)		
YEAR	BILLING (thousands of dollars)	INDEX 1979=100
1979	97,120	100.0
1980	217,440	223.9
1981	317,600	327.0
1982	497,440	512.2
1983	589,360	606.8
1984	1,047,680	1,078.7
1985	1,561,760	1,608.0

Note: data is approximate, due to the conversion that was made from brazilian monetary unit to dollar.

The production of computers began in 1976, in the level of smaller machines. A brazilian enterprise named COBRA was founded and, in order to begin operating and improve its capital, it started mounting a series of minicomputers using FERRANTI's technology (700 series) and SYCOR's technology (400 series). At the same time, in order to produce its own computer, COBRA made large investments on research, employing many qualified people in the country. In 1980, COBRA put in the market the 500 series of minicomputers, which was entirely projected and developed in Brazil. The Cobra-500 computer was the result of several years of research. Its departure was the project of the G-10 computer, that was projected by the Polytechnic School of the University of São Paulo (hardware) and by the Pontifical Catholic University of Rio de Janeiro (software). The Cobra-500 was a great commercial success, with more than a thousand units sold up to 1986.

In 1978, four new enterprises initiated the production of minicomputers, stimulated by the policy of reserve of market, which protected national enterprises. This policy also stimulated the production of peripherals, as video terminals and printers, by the local producer. In 1982, the sales of minicomputers had an increase of 40%, due to the process of banking automation and the role of

the government as an important client. Financial institutions and banks were the main users of minicomputers in the country and, also, they had assets in new technical projects, giving thus a significant support to this segment of market.

In 1983, however, the increase in sales was only 10% - the smallest rate that ever occurred since the equipments began to be commercialized. The trend then was to use microcomputers for its highly attractive relation of cost/performance. From then on, solutions have been found to decentralize work so that demand of minicomputers decreased. To face this situation most suppliers of minicomputers have decided to participate of this expanding market of microcomputers and to develop new projects to produce 32 bits high performance machines (superminis).

In 1985, twenty enterprises initiated a production of microcomputers (IBM-PC compatible), raising to thirty-seven the number of suppliers of this product in Brazil. The microprocessors are imported, but an effort exists to develop the chip technology in the country (for example, the State University of São Paulo has a research project on silicone technology and construction of chips). By 1987, there were more than two hundred enterprises producing computers and peripherals in the country. The biggest ones have been trying to diversify their production in the electronic sector (computers, microeletronic components, peripherals, telecommunication). Table II [Tigre,87] shows the twenty biggest enterprises operating in the country in the informatic sector.

TABLE-II

THE TWENTY BIGGEST ENTERPRISES OF INFORMATICS IN BRAZIL (1985)		
Enterprise	Billing (thousands US$)	Number of Employees
1.IBM do Brasil	820,778	5,000
2.Burroughs	114,923	2,203
3.Cobra	103,658	2,700
4.SID	100,504	1,151
5.Sperry Univac	92,725	124
6.Elebra Informática	61,817	1,450
7.Prológica	53,057	1,530
8.Scopus	49,800	1,170
9.Microlab	43,327	758
10.Sisco	41,213	516
11.Polymax	30,291	532
12.Edisa	29,642	705
13.ABC Bull	29,287	300
14.Helett Packard	26,324	250
15.Microtec	20,005	200
16.Expansão Inf.	18,746	202
17.Medidata	17,629	253
18.Multidigit	13,695	183
19.Moddata	8,649	650
20.Novadata	5,699	80

Note: data is approximate due to the conversion that was made from brazilian monetary unit to dollar.

The mainframe market has been strongly influenced by political factors, such as import quotas. Although these machines are mounted in the country, their production depends mostly on imported components. The Special Informatics Secretariat determines the import quotas in such a way to optimize investments in big machines in the country. In terms of installed park, IBM is the greatest supplier of mainframes in Brazil. It has 55% of the big machines, with 1502 equipments in operation, in a value of US$1,810 billions. Second comes BURROUGHS with 17% of the park and 482 equipments installed. Third comes ABC-BULL. These multinational enterprises produce their equipments in the country, while others - like SPERRY, FACON (Fujitsu), DEC, HONEYWELL, CONTROL DATA - supply the brazilian market through importation means. Although they represent just 5% of the installed computational park, with 2725 equipments, the mainframes represent 75% of the total value of the installed park, estimated in US$3.2 billions.

The financial sector is the greatest demander of data processing equipments in Brazil. The main reason for that is the banking automation process. The banks, mostly private banks, are inclined

to disseminate automation in all their operations. Thus, the participation of the financial sector in the billing of the national informatics industry tend to increase. The industrial sector in turn is also very demanding of data processing equipments due to investments made in industrial automation, specially in the automobile industry. The governmental sector, in turn, has been limiting its purchases to big machines, therefore reducing its participation in the national industry.

It was said we could talk about a consolidated brazilian industry of data processing equipments by the end of the seventies. Since then, importation of such equipments has been reduced and substituted. Suppliers, protected by the National Informatics Law, diversified their products and put in the market various models of small computers and peripherals. Importation became mostly of higher complexity products as mainframes and critical components such as semiconductors and precision mechanical devices. The governmental policy for the informatics sector was to nationalize the equipments produced in the country at most, stimulating local development. The idea was to achieve control of key technologies in informatics. In 1985, the national enterprises imported the equivalent of 8.2% of their sales, while non-national enterprises imported 15.2% of theirs.

The main external market for the brazilian industry of data processing equipments is Latin America (mainly Argentina) and the United States. Usually national enterprises are subcontracted to furnish technology. Elebra Informatica, for example, exported in 1984 US$4.1 millions of printed circuit boards to the American enterprise CONTROL DATA. Three other brazilian enterprises (DIGIREDE, SID and ITAUTEC) were authorized to enter the argentine market of banking automation, either as joint ventures or as furnishers of technology. Exportations of data processing equipments of the country are concentrated mainly in IBM do Brasil. In 1984 it exported US$131 millions, representing 80% of the total exportations (US$161 millions). Nowadays, the IBM's International Procurement Office (IPO, created in 1985) is responsible for the purchases of components and assemblies in the local market to supply the demands of other subsidiaries of the group.

Presently, Informatics is considered a high priority field in the country, so that CNPq (National Council of Scientific and Technological Development) and other financing agencies are strengthening the support to the development of new projects and to the qualification/employment of human resources in this area. It is worth mentioning some recent projects as, for example, the ACP computer. The ACP (Advanced Computer Program) is a prototype of a supercomputer, which was projected and built in Brazil, and is already in operation in the Brazilian Center of Physics Research (CBPF), Rio de Janeiro. It was developed as part of the Program of Experimental Physics of High Energies, with the collaboration of American physics and engineers of the Fermilab Laboratory,

Illinois. The National Council of Scientific and Technological Development (CNPq) and the Financing Agency of Studies and Projects (FINEP) invested US$35 thousands on the project, which is ten times cheaper than an equivalent computer oriented to scientific computation now in the market.

The ACP computer is composed by various units of high speed parallel processing, with thirteen nodes, so that it is of great use for specific applications as experiments in Physics of High Energies. Other important projects are those going on in the State University of São Paulo. There, the first prototype of a supercomputer with a totally national technology, using parallel processing, will be put in operation in this year. It will process 150 millions of instructions per second, deserving 256 terminals and will have an auxiliary memory of ten gigabytes. Its cost is about US$150 thousands, while a supercomputer with ten times the capacity costs US$5 millions. The State University of São Paulo has also a project for constructing a supercomputer in 1989.

CHAPTER II

COMPUTERS IN EDUCATION

The Informatics reached many sectors of the brazilian society. At first, technicians in computer science developed software and hardware for the educational activities (education in the large sense) that were taken up in their environments: universities (technical departments), enterprises,etc. When the idea of introducing this new technology in the elementary and secondary school came about, much was to be debated by the brazilian society before the government established a policy for doing so. This part of the work presents some of the critics made to the use of computers in precollege education, and some of the arguments employed by those who advocates the appliance of this new technology as an additional tool to improve the teaching-learning process in elementary and secondary school. This chapter is based on the excellent essay of Prof. E.Chaves [Chaves,88].

The major critic is the one that questions the adequacy of introducing now the computer in the schools of the country. They say there are some other basic needs in education - adequate operational structure for schools; better earns for teachers; minimum quality level for the room, board and health for students - with high priority that should be thought of first, and, before that these needs are satisfactorily attended, one should not wonder about introducing computers in the schools. On the other hand, defenders of computer use in education agree with the fact that all those needs have high priority but they think the introduction of this technology in education is equally prior. The role of the schools today, they believe, is to introduce the computer to children, make them familiarized with it, show its potential and limits, and teach them how to use it,because tomorrow it can be too late. The education presently ministered at schools should be adequate to the conditions in which students will live and work and, therefore, financial resources for achieving this goal should be claimed as much as for improving the teachers' conditions of work and the students' conditions of life.

Critics may question the priorities. Indeed, the task of giving priority to these social important problems is not a simple one, but deciding what is prior to what is a complex process in which the risk exists of imposing one's personal preferences. Thinking about this question, some important facts should be kept in mind:

1-The information society is taking shape very fast and it is an irreversible process [Masuda,84], not only in brazilian society but also in the international community. Offering students the best possible preparation to live and act in the information society is a social responsibility.

2-Given this fact, many private schools are definitely introducing the computer in the teaching-learning process. The public power, despite the gravity of the problems that affect the public schools, cannot ignore this fact, allowing, thus, to enlarge the gap between public school education and private school education.

3-The public power has a great responsibility in the task of creating the conditions for the cultural and technological autonomy of the nation, thus reducing the distance from the so-called developed countries. Citizens should be familiarized with the basic technological developments in order to participate in the process of generation and incorporation of the technology the country needs. Informatics is in the center of all this technology.

4-Public schools education is deficient, therefore any improvement in teaching-learning process should be considered and welcome. Experiments done at a public school in the town of Santos, state of São Paulo, suggest that repetition in classes of elementary school, using the computer in the process of teaching how to read and write, is reduced by a factor of 5. This improvement also reduces the operating costs of the school.

5-We should worry about Informatics in Education because the available evidence - although this evidence is not so striking as we wish - demonstrates that a ruled and oriented contact of the children with the computer, in a teaching-learning situation, contributes positively to accelerate their cognitive and intellectual development, specially with respect to logical and formal thinking, and to the ability of finding solutions to problems.

There are people that accept the introduction of computers in education but they do not believe it will make much difference, i.e., they think computers may make some of the educational aspects a little more effective or a little more attractive, but they will not affect substantially the students way of learning and thinking, not so much to worth the investments. People who are not in accordance with this idea say that thinking so is to underestimate the computer potential and to

conceive education in a very strict way. Instead of paying attention to the more wide cultural effects that the contact with the computer can bring, they say this group of critics imagine the computer as just a teaching machine that passes information and conceive education as something that occurs mainly through instructions and formal teaching. As being just so, computers will not have much effect on education.

People who think computers in education will not make much difference do not realize that the learning process, even at school, is not just an instructional process. The intellectual development of children, and also the moral and social development, occurs through a series of interactions with the environment where they live and study. The formal teaching is just one of the forms of interaction. As much the environment offers rich and diversified stimuli and resources, as much the children development will be rich, diversified and accelerated. If there are stimuli, opportunities and resources to develop creativity, to explore and discover, children will certainly develop intellectual characteristics that will benefit the creative, exploring and inventive thinking. If, besides these stimuli, the environment offers opportunities to think with rigor, the intellectual development will involve, besides the elements of creativity, the elements of rigor. Many people are relatively skeptic about the educational potential of the computer because they think that its only function is to help teachers to pass curriculum information. However, computers can be used in the learning process as a tool of great value in the children intellectual development.

There are some other people that believe computer can really have a strong effect in education, but they think this effect may be damaging and of undesirable nature. This group of critics say that children contact with computers might lead them to think just one way of thinking: precisely, logically, automatically, kind of a "mechanical thinking". With respect to this idea, two things should be pointed out. First, there is no doubt that in some contexts this way of thinking is appropriate and useful. The difficulties some children have to learn formal contents, such as mathematics or grammar, are often due to the fact that they cannot manage this way of thinking. Second, children in contact with computer soon realize what is mechanical thinking and what is not, being able to choose the most adequate form of thinking for solving a problem. Giving children a concrete and accessible model of a particular form of thinking, the computer makes clear to them the fact that there are different forms of thinking. Giving children the possibility to choose, in certain context, one form or the other, the computer is a mean to develop the ability of distinguishing the situations in which one form is more appropriate than the other. If this is true, an adequately oriented contact with computer can be the best antidote to the monopoly of the "mechanical thinking".

Much has been said about (in favor of it or against it) the use of computers in elementary and secondary school, but a lot of the pedagogical potential of computers is still to be explored. The subject has deserving much attention of the brazilian society through various means, as seminars at the universities ([Barros,87]), theses' works ([Santos,87], [Vicari,85]), books ([Barros,88],[Castro,88]) and specialized magazines ([Ipolito,87], [Leffa,87]). In Brazil, efforts have been made in different directions to investigate the computer use in the educational process. It suggests that the computer's positive effect on children's intellectual and cognitive development does not depend on the type of contact children have with computer, i.e., they can benefit from this contact through different ways: programming, learning formal contents, doing simulations, using support tools (text processors, data base managers, work sheets, etc), or as a leisure activity (games). Children have at their disposal a powerful instrument with which they can think and learn.

CHAPTER III

DIRECTIONS OF WORK

This part of the present work deals with roughly two types of initiatives towards the application of Informatics in Education: governmental and private ones.

III.1. Government initiatives

Ultimately, we have been witnessing an extraordinary technological progress in the areas of telecommunication and of informatics. The computer has shown to be a strong agent that acts on the productive processes and habits of the society, making great changes on them. Informatics, when applied to one of these processes in particular - the educational processes - brings about a conceptual change, that influences the act of thinking and teaching, thus requiring a special attention. The Ministry of Education gave directions to organize and rationalize the use of informatics and of the new communication technology in the teaching-learning process. The determination of the brazilian government of using Informatics in Education is presented in several documents and pronouncements:

-The program "Education for All", which has as one of its objectives to give people more opportunity of access to elementary school, points out the improvement and the intensification of the activities of informatics (education using telecommunication means) in the teaching-learning process as a mean to achieve this objective.

-The plan of the Ministry of Education and Culture "Informatics and Education", June 1985, comprises four sectors of the educational sector (Research, Teaching, Extension, Administration) and foresees the use of Informatics either as educational technology or as a mean to improve administration. This plan integrates the National Plan of Informatics and Automation.

Presently the main governmental initiative is the EDUCOM project. The EDUCOM project (Education by Computers) is a project of the brazilian government to apply informatics as a technological resource in the national educational process. It deals mainly with precollege education

and most of the work is carried out by the universities. Nowadays, the project is being developed by the federal universities of Rio Grande do Sul, Pernambuco, Minas Gerais, and Rio de Janeiro, and by the State University of Campinas (depends on the state of São Paulo), with all the hardware resources used in the project supplied by the national industry of informatics. The information presented in this part of the text is based on the official document published by the Ministry of Education [CEN,87], and on the interviews and *in loco* observations made by the author.

III.1.1 The EDUCOM project: historical background

The creation of the Special Informatics Secretariat (SEI), in October 1979, brought significant changes in the sector. Besides the activities to rationalize computer use and to develop human resources, the Secretariat worried about the implementation and the consolidation of the national park of informatics, supporting research projects. The sectors of Health, Education, Agriculture and Industry were considered the ones with highest priority to the application of specific projects, due to the strong social impact that the informatics activities have had in these sectors.

Five months after its creation, in march of 1980, the Secretariat created a Special Commission of Education, showing its interest in participating in the discussion about the use of computers in the teaching-learning process. The Secretariat gave to the Ministry of Education and Culture the necessary means to create rules and directions to this new field of education.

In august of 1981, the Ministry of Education and Culture, the Special Informatics Secretariat, and the National Council of Scientific and Technological Development (CNPq) organized the First National Seminar of Informatics in Education. The relevant considerations, suggestions and recommendations that resulted from this Seminar are:

1-The participants emphasized the need for better performance and better quality of education, specially in medium and high levels, in face of the advance of the technological and organizational standards in the society. At the same time, they recognized that, in Brazil, there is a situation of serious unbalance in educational opportunities, preventing general access to elementary school, and they recognized that the computer use in education cannot, at short or medium time, finish the mentioned unbalance. Nevertheless, participants concluded that the computer, used adequately, could help improving performance and quality of the education offered.

2-They warned, however, that the software, specially the so-called educational software, brings in it cultural, political and ideological influences, many times in a hidden way, that can be undesirable. Thus, they recommended that all the uses of computer in education should observe the cultural, social, political and pedagogical elements in order to be in accordance to the brazilian reality.

3-Considering , yet, the risks involved in transferring technology in this area, and the difficulties the national groups would have to compete in this market, due to the high costs of development, maintenance, and marketing of the instruction material, they concluded there should be a policy of fiscal inducements and financings to national manufactures of hardware and software for educational purposes. Users of these national products should also receive grants and protection for the investments made.

4-The participants advised also that the pilot-projects of informatics in education should be made - projects of inter-disciplinary nature, that should be kept on by universities with technological capabilities in both areas (informatics and education). The objective was to research the computer use in education (formal and non-formal), keeping direct involvement with teaching institutions, and to give priority to the regular studies of elementary school, secondary school and undergraduate school.

5-They recommended that the projects were made in such a way to cover all regions of the country, and that emphasis were done to two things: the qualification of human resources, to assure the success and perpetuation of the project; and the development of educational software by national groups.

6-They recommended, also, that the technological-economical aspects of these initiatives were regarded, not in function of the pressures of market, but in function of the social-educational benefits that a project of this nature could generate, and in accordance of other investments made in education in the country. It was remarked the investments made in the use of computers in education should not substitute investments to improve the work conditions of the staff and students. They emphasized, however, that costs should not be an impeding factor for the implementation of the project.

7-They remarked, at last, that the computer use in education, though it can be advantageous in some specific fields, it should not be regarded as a panacea capable of solving the problems of basic education or of substituting efficiently all the needs of the staff and basic institutional resources.

In October of 1981, a Symposium of Informatics in Education took place in the XIV National Congress of Informatics (the First International Fair of Informatics was presented in parallel), under the sponsors of the Special Informatics Secretariat (SEI), the Ministry of Education and Culture, the National Council of Technological and Scientific Development (CNPq) and Financing Agency of Studies and Projects (FINEP). The main purpose was to listen to the opinions of the community and to collect data in order to make a plan for the development of new experiences using the computer in the teaching-learning process.

In December of the same year, the Ministry of Education and Culture released its first document about the use of informatics in education: "Grants for the Implementation of the Program of Informatics in Education". Two were the decisions taken by the Ministry upon this document: to estimate costs of the pilot-centers, and to propose the creation of a Special Commission of Informatics of Education. In 1982, the Special Informatics Secretariat (SEI) studied the organization of this commission which was created short after (January of 1983), linked to the Secretariat. The Commission is nowadays constituted by representatives of the Ministry of Science and Technology, the Ministry of Education, and the Ministry of Communications. Its main functions are:

1-to propose a policy of informatics in the teaching-learning process.
2-to support the implementation of the pilot-centers oriented to the application of the informatics technology in education.
3-to recommend hardware and software to be used in education.
4-to coordinate the distribution of governmental resources.
5-to qualify human resources for the project.
6-to make the follow up, the evaluation, and the dissemination of the results.

In August 1982, exactly one year after, it took place the Second National Seminar of Informatics in Education, in the Federal University of Bahia, again under the sponsors of the Special Informatics Secretariat (SEI) and the support of the Ministry of Education and of the National Council of Technological and Scientific Development (CNPq). In this second seminar the participants were divided in four groups. The first one was joined by the persons interested in the pedagogical-

educational aspects of the problem; the second, by those interested in the psychological-educational aspects; the third, by those interested in the social-educational aspects; and the fourth, by the persons interested in the aspects related to the computational problems. The considerations, suggestions, and recommendations pointed out in the first seminar were still considered relevant in this second one.

Based, in part, on the recommendations of the Special Commission of Informatics in Education, the Special Informatics Secretariat (SEI), in August 1983, invited the institutions of undergraduate studies to present a project to create pilot-centers. These centers would be installed in brazilian universities, and their purpose would be to investigate the use of the computer as an auxiliary instrument in the teaching-learning process, specially at secondary school. They would also have the functions of qualifying human resources, following up, evaluating, and disseminating the results. The dead line for project's submission was October 31,1983.

Twenty-six universities presented their projects, which were analyzed by a technical committee of the Special Commission of Informatics in Education. In December of 1983, the committee recommended the approval of the projects of the following universities: Federal University of Rio Grande do Sul (UFRGS), Federal University of Minas Gerais (UFMG), Federal University of Rio de Janeiro (UFRJ), Federal University of Pernambuco (UFPE), and State University of Campinas (UNICAMP). The proposal of the committee was approved by the Special Commission of Informatics in Education, that delivered its decision in July of 1984.

The Ministry of Education and Culture, as the one responsible for the educational aspects related to the field of informatics, had already prepared itself to fulfill effectively and conveniently the demands generated by the introduction of the new technology. In order to have a flexible and responsive operational structure, the Ministry approved the transfer of the Center of Informatics (CENIFOR) from the Special Informatics Secretariat (SEI) to the Foundation Brazilian Center of Educative Television (FUNTEVE), a governmental organism that supervises and coordinates the development and the application of educational technologies. The Center of Informatics had the attribution of developing, stimulating and disseminating educational technologies of informatics in the governmental sphere and in the community, as well as to support the units of the Ministry that made research and services in the field.

In July of 1984, representatives of the Ministry of Education and Culture, SEI, CNPq, and FINEP made the compromise of supporting financially the installment of the pilot-centers. The FUNTEVE, through its Center of Informatics (CENIFOR), was in charge of the technical coordination of the project. The EDUCOM project had an estimated cost of US$217,504 for its first year (1985). Its pilot phase is estimated to finish in 1988.

Playing its role of coordinator and supervisor of the EDUCOM project, the CENIFOR established the systematics for the follow up and the evaluation of the project, involving the financing agencies and the coordinators of the pilot-centers. The systematics defined had the objective of identifying two things: the purposes of the initial project presented by the universities taking part in the experiment; the directions of work of each center, giving chance to bring about alternative ways to the execution of the project. Besides having a close image of each center, it would also be possible to have a wide vision of the project as a whole. It was intended to collect data to form an information center open to interested people and to help planning the activities for the following years of the project.

Four phases were defined for this systematics of evaluation: auto-evaluation, integrated evaluation, evaluation by sector, and global evaluation.

1. Auto-evaluation- It is done by the analysis of the reports elaborated by the pilot-centers, describing their activities and relating them to the parameters established by the initial project, which was presented by the institution and approved for development.
2. Integrated Evaluation- The pilot-centers are visited by representatives of the CENIFOR, of the financing agencies, and of other pilot-centers. The objective is to integrate the CENIFOR with the financing agencies and to improve the exchanges of experiences among the pilot-centers.
3. Evaluation by Sector- Based on collected data and observations done during the visits to the pilot-centers, and based on the reports elaborated by the coordinators of the centers, it was possible to form a clear view of the situation of each center.
4. Global Evaluation- Conclusions were taken about the validity of the EDUCOM project as a whole, and these conclusions oriented the proposals of work of each pilot-center for the following year.

The Universities that had their projects approved by the Special Commission of Informatics made the compromise of doing a research job, gathering people of different areas as Informatics, Education, Psychology of Learning and Development, Educational Sociology, etc. They also made the compromise of keeping in mind the brazilian cultural values while doing the task of developing educational software. Thus, although the project of each university has its own characteristics, they are oriented by the general principles that were established in the two National Seminars of Informatics in Education. Following, the main lines of the work done in each university are described.

III.1.2. Executive EDUCOM Subprojects

Subproject EDUCOM/State University of Campinas (UNICAMP)

The State University of Campinas, many years before being chosen to integrate the EDUCOM project, had been developing activities in the area of informatics in education. In 1973, some people began to go abroad to make a stage at the LOGO Laboratory of the Massachusetts Institute of Technology. There, they got in contact with the work of the creator of the LOGO philosophy and language, Seymour Papert ([Papert,80], [Papert,81], [Papert,82], [Papert,84]), and with the work of one of the main researchers in the area of artificial intelligence, Marvin Minsky ([Minsky,68], [Minsky,75], [Minsky,77], [Minsky,85]). The consequence of this interchange was the creation of a research group in the University of Campinas, formed by experts of different areas - Informatics, Linguistics, and Education. Soon, graduate students of the university began to write their theses on the subject (computers in education), thus increasing the amount of qualified human resources in this area of research, available in the country.

In 1977, two projects of research were elaborated by the group and were submitted to governmental organisms for financing. Due to the originality contained in the projects' idea - the first microcomputers, APPLE, PET, and TRS-80 Model I, would begin to be sold by the end of 1977 - none of the two projects were approved, for, by that time, they did not match the priorities of the sponsoring organisms.

The LOGO project of the State University of Campinas was the first in its nature to be implemented in the country, when there were few people, even abroad, that were worried about Informatics in Education. Its initial purpose was to introduce the LOGO language in Brazil, making it suitable to the brazilian reality, and make a study (developing systematic activities with children) to observe the influences of the LOGO environment in the learning process. So that, in 1983, the institution was ready to present a mature project to the Special Informatics Secretariat (SEI), in order to take part in a wider government plan of computers in education (EDUCOM).

The main objective of the subproject EDUCOM/UNICAMP is to create favorable conditions to an adequate use of computers in education. The best way to achieve it, they believe, is to qualify human resources in order to make this adequate use. It is expected that these people, trained and touched by the project, are the people who will take part in the long and hard task of developing educational software. Other ways are: to participate of scientific meetings and other public events in order to move people to the subject; to publish texts that discuss the basic questions related to the subject; to give courses and conferences about the subject; etc.

This subproject is based mainly on the philosophy that oriented the creation of the LOGO language, as a mean for using the computer in the teaching-learning environment. Three LOGO environments were created in public schools (primary and high schools) located around Campinas. They differ from each other in the social-economical aspects of the children. Data collected after 1980, in the experiences made with children at UNICAMP, were taken into account to create these environments. The objectives are:

1-To adequate the basic ideas of the LOGO language to the reality of the public schools of the region.

2-To develop didactic material and to promote the training of teachers that could, in fact, apply in class, in the regular curriculum, the basic ideas of the LOGO philosophy.

3-To evaluate the teaching-learning process in the LOGO environment, in the context of public schools of the region.

4-To make a fundamental study of the learning process for children of different social-economic levels, but submitted to the same stimulus. Thus, the theoretical bases of the activities being developed would be widen.

The version of the LOGO language that is used by the children in the project's activities is a version translated to Portuguese and implemented in the microcomputers of the series I-7000 (compatible with IBM-PC) manufactured by ITAUTEC.

It is worth mentioning the work that has been done by the researchers of UNICAMP in relation to handicapped children [Valente,83], using computers to improve special education. Professionals of the field (physiotherapists, pedagogues, occupational therapists, etc.) were trained to work with the LOGO language, and to use it in their pedagogical activities. The objective of this project is to research the pedagogical, cognitive and therapeutic needs of handicapped children, train teacher in the use of computers and build up a model school where these children can become productive and prepared to life. Adequate hardware features were developed and implemented in order to allow children with poor motor coordination to "command" the computer.

Subproject EDUCOM/Federal University of Minas Gerais

This subproject has the objective of generating and disseminating experiments of the use of informatics in education through the development, application and evaluation of educational software specially for secondary school studies. Experts of different areas (Education, Philosophy, Computer Science) are engaged in this task, taking into account the aspects of the brazilian reality in order to

preserve the national culture, applying and evaluating the software produced in public schools and in the laboratories of the university to public schools. The subproject is expected, in a wider context, to benefit the national industry of informatics, joining the efforts to consolidate it.

Besides the activities for developing, applying and evaluating the software developed by the project, there is also a great concern for activities to qualify human resources. The school staff is given basic courses in computer science, is trained to be familiarized with the equipments, and is followed up through meetings and discussions.

Educational software was developed for teaching Physics, Mathematics, Biology and Portuguese in the curriculum of secondary school, using the programming language SUPERPILOT and microcomputers compatible with the series APPLE. The pedagogical premises taken are based on the work of the Swiss Jean Piaget ([Piaget,48], [Piaget,49], [Piaget, 68], [Piaget, 76], [Piaget,77]) and of the Russians S.Vygotsky ([Vygotsky,62], [Vygotsky,84]) and G.S.Kostiuk ([Kostiuk,77]).

A study of a computer system adequate to the brazilian schools are being made at the university, in order to analyze the possibility of using the microcomputer DCC2600, entirely projected and built in the Computer Science Department / UFMG, as a standard in the brazilian schools. The DCC2600 microcomputer supports multiple terminals (compatible with the series APPLE) and multiple tasks by terminal, accepting very modular expansions. It has a very flexible multiprocessing system (up to sixteen processors), sharing a total memory of 16MB. The purpose is to install several of these microcomputers in each school, connecting each other in a network, and each network to others, and to provide the necessary software for operation.

Subproject EDUCOM/Federal University of Pernambuco (UFPE)

The subproject EDUCOM/UFPE has the following purposes: to develop an interdisciplinary methodology to implement educational software; to develop a local network of low cost to be used in the teaching-learning process; to study the social cultural aspects and the social political impacts of the use of computers in education.

The first purpose is intended to be achieved by the preparation of didactic material adequate to the use of the software; by implementation of educational software to the teaching of mathematics (elementary and secondary school); by the application and evaluation of the courseware in local public schools; and by qualifying human resources. Several coursewares for teaching Mathematics were developed and implemented on microcomputers compatible with the series APPLE, in the public schools. Also, children of elementary and secondary school are engaged in programming activities

using the LOGO language. Researchers agree that to produce educational software it is necessary an interdisciplinary team composed of teachers, programers, experts in artificial intelligence, psychologists, pedagogues and sociologists. They have been analyzing educational software commercialized in the national market and defining criteria to evaluate this kind of software.

The second purpose is the interconnection of various microcomputers of minimum configuration to a microcomputer equipped with peripherals adequate to be used in the teaching environment, thus trying to reduce the global cost of the computational structure. A study has been made to define a network architecture suitable to the educational environment. A protocol was written to support this service and a communication board for microcomputers compatible with the series APPLE is being developed in the laboratories of the university.

The third purpose is to investigate the consequences of the new technology - informatics - in the internal relations of power in school and in other systems of social relations linked to educational activities. It is under study how the use of computers in a certain discipline can modify social cultural habits of students and teachers, changing, thus, the existing socializing processes of the educational environment. Sixty teachers (fifty percent working in private schools and fifty percent working in public schools) were interviewed with the purpose of investigating what kind of information they had about computer technology applied to education and how they felt about it ([Mariz,85], [Hofmeister,84]). Roughly speaking, "accuracy" and "speed" were often regarded as positive aspects of informatics in education, and "unemployment" and "inhuman society" were often taken as negative elements.

Subproject EDUCOM/Federal University of Rio de Janeiro (UFRJ)

The purpose of the subproject EDUCOM/UFRJ is to elaborate an experiment to introduce the use of computers in high school education and to evaluate the effects of this technology with respect to the learning process, to the teacher's style of work, to school organization and to the impact on the community. This purpose is intended to be achieved through the development of software and hardware and through the qualification of human resources to make adequate use of this technology.

The disciplines of Mathematics and Sciences were chosen to begin with, mainly because of the possibility of being easier simulated in a computer and because of the poor performance most students had in these disciplines. Software was developed for microcomputers compatible with IBM-PC, using the programming language BASIC, and for minicomputers using MUMPS Experts of

different areas (Education,Psychology, Sociology, and Informatics) as well as the school teachers take part in this subproject.

Subproject EDUCOM/Federal University of Rio Grande do Sul (UFRGS)

This subproject is constituted by three executing units: Laboratory of Cognitive Studies (LEC), Faculty of Education (FACED), Center of Data Processing (CPD). These units, integrated by experts of different areas as Psychology, Medicine, Physics, Mathematics, Pedagogy, Linguistics, and Computer Science, develop research activities, qualify human resources and elaborate educational software. They differ from one to another in some aspects but they have the same basic purposes.

The Laboratory of Cognitive Studies (LEC) investigates the problems involved in the learning process and the cognitive development of children. It has been doing so since 1973, under the focus of the Theory of Piaget ([Piaget,50], [Piaget,66], [Piaget,68a], [Piaget,70], [Piaget,76]) and the work of Paulo Freire ([Freire,83]). By the time the study of children interaction with computer began, a revision of literature on the subject was made and it showed up that there was still much to be known. In face of this, the objectives for this group of work were defined as follows:

1-To introduce microcomputer programming with the LOGO language as a resource that aids students learning.

2-To elaborate a model of cognitive interaction to improve teacher-student interaction in the work with computer.

3-To produce material of cognitive orientation that introduces the students to the experimental exploration of contents, through the programming activities.

4-To train the staff (teaching personnel) to disseminate the model made for the programming activity in such way to develop more effectively the students reasoning and thus make them learn easier.

From 1973 to 1979, the Laboratory made research on some aspects of the cognitive development that had not been investigated by Piaget (mainly in the field of visual perception and mental operations). During this period, the Laboratory kept contact with other piagetian groups of research (including Genebra), advised official teaching institutions, trained professionals, and contributed to the formation of school psychologists.

In 1979, contacts with the LOGO group of the Massachusetts Institute of Technology (MIT) began to take place and since then the Laboratory has been investigating the cognitive process of children, using as a tool the LOGO programming language. This investigation take into account the work of Piaget, trying to deepen previous research and to approach the problem of learning

difficulties. The LOGO language was chosen due to the relation between the works of Papert and Piaget, and due to the educational philosophy which is behind LOGO ("a language to learning"). The Laboratory has developed some "seed-programs", written in LOGO, to teach contents of the curriculum (elementary and secondary school), as Mathematics, Portuguese ([Axt,86]), and Physics.

Besides the experiments done with children attending regular courses of public schools, some are also being done with repeaters, also with children with emotional and cognitive problems. Regarding the cognitive functioning of children under psychological treatment, researchers investigate the therapeutic effects of programming activities with LOGO. They do "computer cognitive therapy" in children with learning problem attending public schools in urban periphery.

The group of the Faculty of Education (FACED) has been using authoring systems (mainly the CAIMI system) for teaching contents of Biology, Physics, Mathematics, Sciences, and Social Studies. The system is implemented in microcomputers and used by children in public schools as part time activity. The team has the following objectives:

1-Development of interactive systems for teaching (simulations), for formative evaluation, and for learning (solutions of problems in BASIC and LOGO) through microcomputer.

2-Study about variables cognition (learning, cognitive abilities, mental models) and variables of affection (motivation, attitude, self-esteem) in the interaction student-microcomputer-teacher.The relation among these variables are also to be studied.

3-Qualification of human resources (students,teachers, and technicians).

The Center of Data Processing (CPD) is organized in four subunits: Center of Educational Programs, CAIMI, Formation and Training of Personnel, Project and Development of Educational Support Systems. They are executive units pursuing the following objectives:

1-To qualify human resources to use computer as a support to the teaching-learning environment.

2-To develop computer systems to educational purposes.

3-To apply existing computer systems for educational support in order to improve them and make use of them.

4-To research and to develop computer systems using artificial intelligence techniques.

5-To develop, together with teachers of elementary and secondary school, the necessary material to the use of microcomputers.

6-To improve systems of educational support developed during the project.

7-To establish, through final evaluations, new areas of application for the systems developed.

The Center of Educational Programs gives teachers and the community in general the necessary information to use educational programs and even to develop their own applications. The subunit entitled Project and Development of Educational Support Systems has been developing a system that generates and manages instructional programs. It is to be implemented in a microcomputer with graphical facilities and it will use techniques of computer assisted instructions. The subunit for Formation and Training of Personnel develops material to help teachers in public schools (elementary and secondary level) and professors of the Medicine courses of UFRGS to use interactive systems for teaching. CAIMI, in turn, is the name of a brazilian authoring system. The unit of the same name supports and develops improved versions of this system.

The Center of Data Processing has been using computers for teaching and evaluating students since 1973. At first the SISCAI system was developed - it interacted with the students, managing the information, questions and feedback given and presenting the content in the rhythm of the student. SISCAI was implemented in a computer B-6700, having been used in FORTRAN courses with very good results. In the eighties, a new instructional software for microcomputers was developed, following the international trend of using small systems. CAIMI (CAI for microcomputers), as it was called, was the first brazilian software to help the creation of lessons, developed for small machines, presenting the following advantages on SISCAI: shorter response time, greater availability of the system (dedicated to one user only), greater portability. CAIMI has three basic modules:

1.Module of the Teacher

Allows authoring the courses in an interactive way, without requiring previous knowledge or experience in Informatics.

2.Module of the Student

Allows studying and reviewing the contents prepared by the teacher and accomplishing exams.

3.Module of Statistics

Gives the teacher statistical information about the performance of the student.

For confidence purposes, there are three levels of access: the one of the coordinator (may create/delete courses or users' passwords), the one of the teachers (access to the authoring module and to their courses); and the one of the student (access to the student module only). Support software easy to be operated by end users are also available. CAIMI was implemented for ITAUTEC microcomputer and for other national equipments compatible with the APPLE series.

Out of the EDUCOM project, there are many independent smaller projects going on in other federal universities, private colleges (through federal financial support) and other governmental institutions. Some of the examples are: the system for teaching electrocardiography ([Lima,87]) developed in the Federal University of Santa Catarina, with the cooperation of the Institut d'Informatique, FUNDP, now in use at the Medicine courses; the project for teaching Geography , using PROLOG language, developed in the Pontifical Catholic University, Rio de Janeiro; the children's work with LOGO at Abel Institute, Niterói [Fróes,87], simulation software used in the medicine courses of the State University of Campinas.

III.2. Private initiatives

In the case of private initiative the main orientation is the adults training in specific fields. Training people in their new functions has been a problem of great concern for many enterprises. Time and costs are meaningful factors in this process, so that efforts have been made to introduce effective techniques that improve training quality. Computer technology has shown to be of great use for achieving this goal. The description of a software product (TIC), developed by a national enterprise called MEDIDATA SISTEMAS, will follow as an example of computer assisted learning in the private sector.

TIC (Computer Interactive Training) allows individual training and supports multiusers. Users may receive the training in different moments (according to their own availability of time) and in different places (in their own working environment). Therefore, the organization can avoid direct costs of locomotion and indirect costs of changing too much, and for long, people schedule of work. The main features of the software are:

-operation in either a monouser environment or a multiuser environment.

-system modules are related to external entities: Learner Module, Author Module and Supervisor Module.

-interactive dialogues, so that Learner can do without manuals.

-hints, glossaries, explanations and suggestions that stimulates immediately the Learner's contact with the system.

-great number of functions to create and to maintain lessons.

-evaluation of Learner's performance in different levels specified by the Author.

-statistics for control and supervision.

-record of Learner's participation with comments about questions of the course, and about the course as a whole, giving a feedback to the Author.

-operation in network, allowing prepared courses and learner's evaluation to be transferred by teleprocessing.

The Supervisor is responsible for managing courses and Learner's evaluation. The Supervisor of the system initializes the working environment by informing users (Learners and Authors) and opening titles of courses that will be created by the Authors. The Author's responsibility is to organize the course in sections, topics and screens, define questions and expected answers, decide the conditions for branching and for test application, determine evaluation criteria. The author can also create a glossary that is automatically available to the learner while he takes the course. The author is also responsible for writing the messages that will be used in the dialogue between system and Learner.The Learner's responsibility is, obviously, to take the course. TIC was projected in such a way that the Learner, sitting down in front of the terminal, will receive total assistance, through detailed instructions of how to proceed and on line help in any point of the course. The following functions are available to the Learner:

"GLOSSARIO" (GLOSSARY)
allows consulting the glossary of the course. Learner informs the word he wants to know and the system exhibits its meaning in the screen.

"DICA" (HINT)
gives a hint to the question the Learner is trying to answer.

"COMENTARIO" (COMMENT)
allows Learner to make comments on different points of the course.

"INTERROMPE" (INTERRUPT)
allows interruption of the lesson. The system registers the screen where the interruption occurred so that allows Learner to retake the lesson at the same point where there was an interruption.

"REGENERA TELA" (REGENERATE SCREEN)
exhibits again the screen in use.

"RETROSPECTIVA" (RETROSPECTIVE)
allows making a retrospective of the screens presented up to the point of the lesson the Learner is. The Learner demands as many past screens as he

wants, the system exhibits them without requiring answers to the questions and returns to point of the demand.

"EXPLICACOES" (EXPLANATION)
explains the available functions as was done above.

Conceiving a question, the Author has many forms available in TIC to present it to the Learner. The Author can choose the form best adequate to subject and also avoid Learner's tiredness by varying the forms. For each type of question the Author can also define a hint to be presented by the system if the learner asks for. The types of questions are:

"SIM"/"NAO" (YES/NO)
TIC will accept only one of these options. The author defines which one is correct, writes the message that will be exhibited in each case and determines the deviation logic for each option.

"MULTIPLA ESCOLHA" (MULTIPLE CHOICE)
TIC supports up to eight options for this type of question.

"ASSOCIACAO DE COLUNAS" (COLUMN MATCH)
TIC allows the Author to define two columns with up to eight pairs to be matched. The author determines the messages, the deviations and the minimum number of correct associations for the question to be considered correct.

"TEXTO LIVRE" (FREE TEXT)
the Learner types a free text. The author responsibility of defining a model for the answer, making use of logical operators and strings, defining messages and deviation logic.

TIC keeps register of the work of each student if the Author wants to. Thus, it is possible to have a follow up report, containing details of all the work the Learner has done. For each question are presented: the answer given; indication of correctness; time for answering; comments that might be made. Yet, at the end of a topic or session, are presented: total number of answers; total number of correct answers;percentage of correct answers; average time for answering the questions. TIC has security features as maintenance of user's dossier; controls user's access in different levels (module, routine, peripheral); restricts the access to the system to certain terminals; controls LOG, and all

activities of the system; allows blocking the system. TIC's documentation is constituted by the Manual of the Author, the Manual of the Supervisor and the Manual of the Learner.

We should also mention several private schools (precollege level) that develop educational software as a tool for teaching contents of the curriculum ([L'Amiral,87], [Youssef,87]), using machines supplied by the national industry (compatible with IBM-PC and APPLE series).

CHAPTER IV

PERSPECTIVES

A problem arises when we try to define precisely what an educational software is. The question of what is an educational software seems to be sometimes hard to answer precisely. Is a text processor an educational software? And a programming language. COBOL would hardly be considered so, but what about LOGO, PILOT, maybe PROLOG or even PASCAL? A game can be considered educational? What kind of game? What about the expert systems?

What are then the criteria for a software to be considered educational? Efforts have been done to define these criteria and to evaluate this kind of software ([Oliveira, 87]), but, however, a reasonable proposition ([Chaves,87]) is to consider educational the software that can be used with any defensible pedagogical purpose, no matter the nature or finality with which it has been created. Thus we can enlarge the possibilities of achieving the educational objectives we want, with the aid of computers, using not only specific software (the one designed to Education) but also general software (text processors, data base managers, worksheets, etc.).

Teachers and students should get more involved. They should be given conditions (time, training and support material) to find out and foresee ways computers and software can be useful, concerning the educational objectives they themselves have defined. Some isolated personal initiatives are being observed ([Baltra, 86]), that is, teachers by their own incorporates software tools available in the market to their day to day work in the classroom, according to their pedagogical purposes.

Education is a very rich and complex phenomena that cannot be approached in just one way. It has a broad range, dealing not only by the learning achieved by discovery but also with the learning proceeding from formal and deliberate teaching. Education has to do with formation but also with the transmission of information. In the educational process, there is the interchange between tradition and critics, allowing the evaluation of this tradition and a possible reformulation. It is important, thus, to have an open mind in order to allow and encourage the most different experiences. It is the multiplicity of points of view that will enrich the learning environment. It is important not to limit the possibilities and encourage various directions of work and research.

The researchers of the five pilot-centers of the EDUCOM project make the following recommendations for the future:

-to intensify exchange of information among the pilot-centers, consolidating their activities: publications; theses presented; software developed; participation in scientific meetings; courses and training offered; cooperation with other institutions; number of schools involved; number of teachers trained; number of students benefited; number of equipments acquired.

-to support other lines of research in the field, that are carried on by groups of other brazilian universities out of the EDUCOM project.

-to involve the teachers in the selection/definition of educational software.

-to preserve the brazilian cultural values.

-to develop national technological competence.

-to set up a reserve of market for educational software.

-to develop methodologies as well as final products of software as results to be achieved.

-to obtain governmental support for the development of educational software, assuring th Public Power the autonomy in the production, evaluation and dissemination of programs to be used in public schools.

-to ratify of the conclusions of the I and II Seminars of Informatics in Education.

The improvement of the production of educational software is something to be regarded. Inducements should be given to software-houses interested in this market, but, with respect to the development of software for pre-college education, they should keep contact with elementary and secondary schools. Also, the universities should be sponsored to develop this kind of software and to create interdisciplinary graduate programs that involve professionals of education interested in computer literacy ([Van Dyke,87]) as well as professionals of informatics interested to be acquainted with educational subjects. The qualification of human resources necessary to introduce computers in education would thus be improved.

The role of the teachers in the classroom and of the school administration personnel is known to be a very important one for the success or for the failure of informatics in education. It is necessary to make them more involved in the process and stimulated, in part through mass media communication, in part through leadership of someone that conducts the process locally. The government should stimulate research even more, to sponsor a greater number of universities working in this field, so that the brazilian Project of Informatics in Education achieve the results for which it was created.

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